Portage Glacier
Chugach Mtns
Spring 1976

Pathogen Diversity in the Arctic Arena:
Implications for Ecosystem Sustainability and Human Health Under Accelerating Change

Arctic Biodiversity Congress/ Trondheim, Norway 2 December 2014

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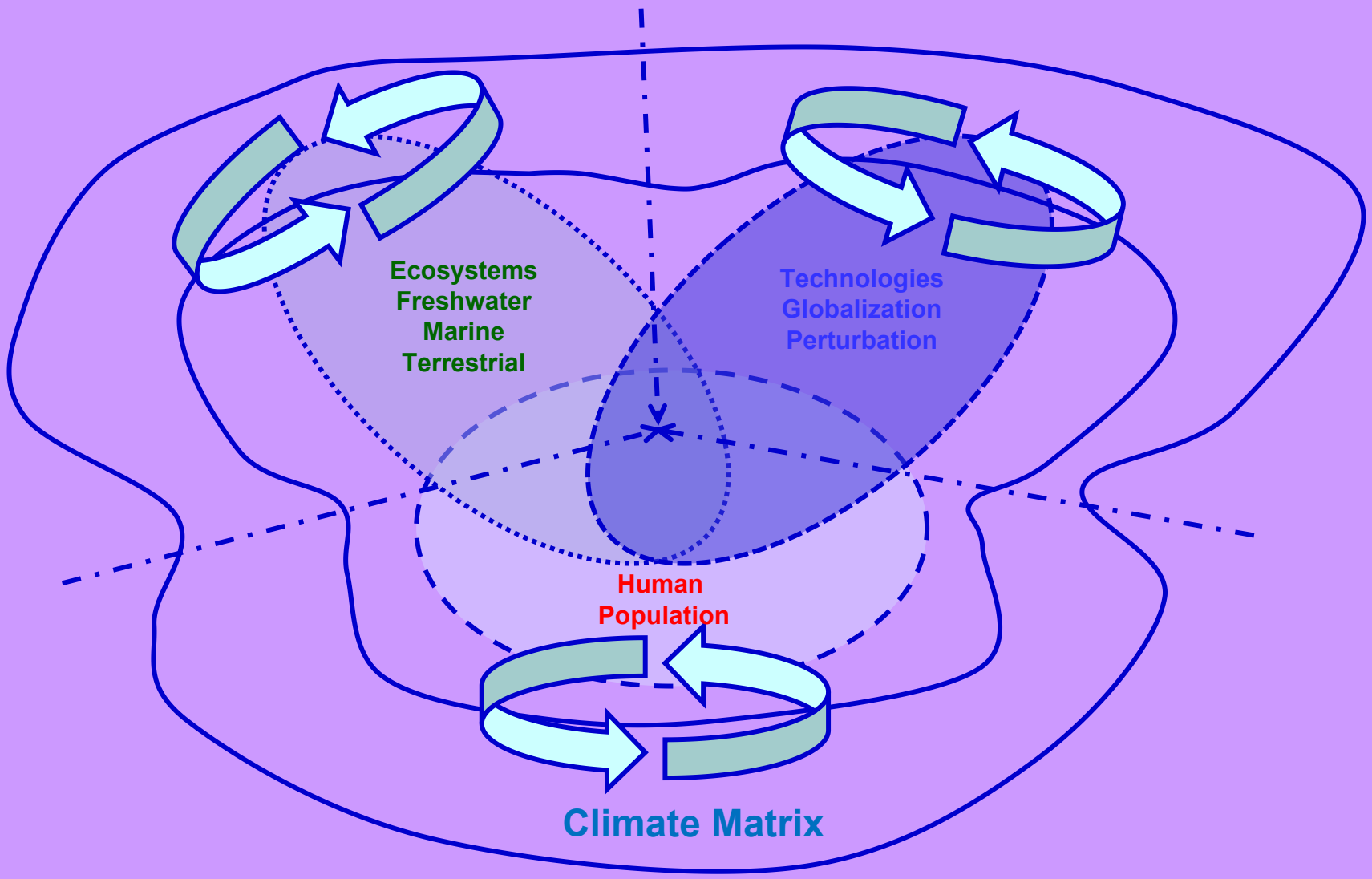
Intersections for Pathogen Flow



Brooks & Hoberg, 2013/ Balance of Nature/ Cambridge Univ Press

Arctic Coastal Plain
Chukotka –
August 1981

Agricultural Research Service

An Integrated Perspective on Pathogens of the Arctic

Eric Hoberg, US National Parasite Collection

Susan Kutz, University of Calgary

Kurt Galbreath, Northern Michigan University

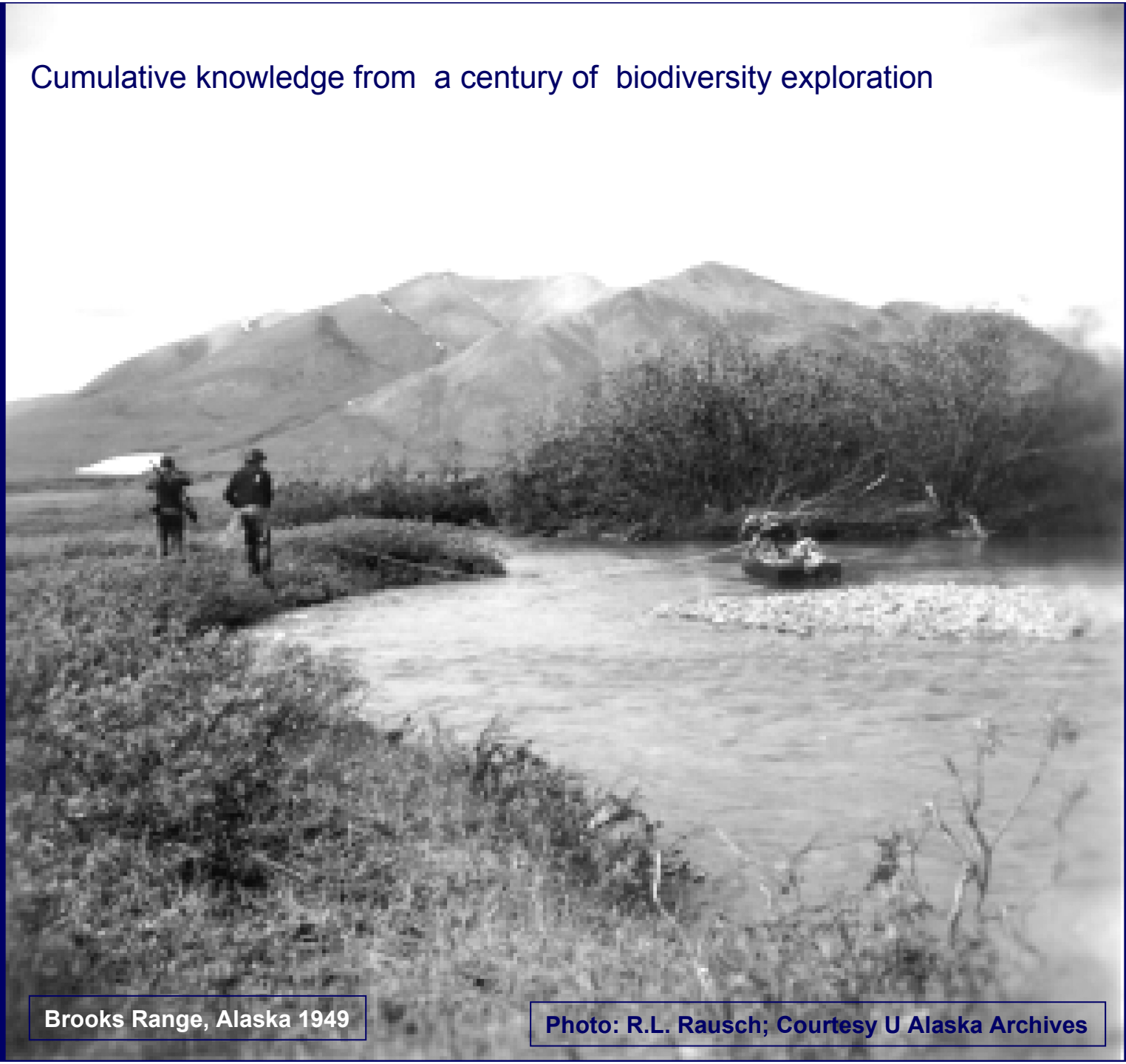
Joseph Cook, University of New Mexico

Parasitological Insights-

Parasites place complexity and history on the table.

Evolution is the science of understanding consequences, both to reveal the past and to inform future decisions.

Cumulative knowledge from a century of biodiversity exploration



Brooks Range, Alaska 1949

Photo: R.L. Rausch; Courtesy U Alaska Archives

Arctic Parasite Context-

- Viruses, Bacteria, Protozoa, Fungi, Metazoa
- 40-50% of global diversity/ 75% trophic links
- 7100 spp. metazoan parasites in vertebrates
  - Validate diversity through survey and inventory
  - Diversity of viral and bacterial pathogens?
- Considerable cryptic diversity?
- Absence of long term baselines
- Highly responsive to perturbation

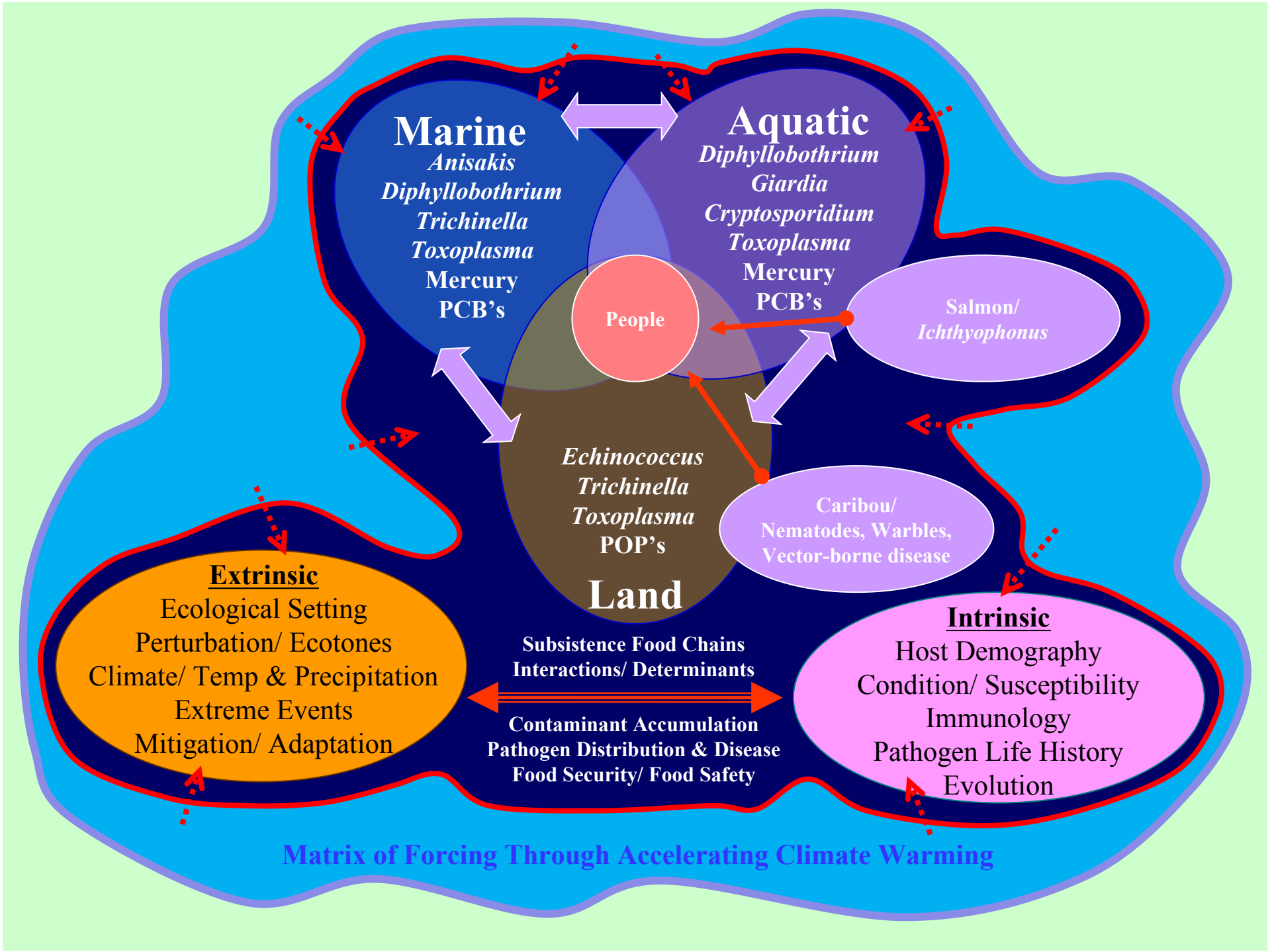
Themes for a Northern Fauna

- Dynamic climate variation over time
- Crucible of Ecological Perturbation
- Episodic, cyclical or recurrent processes
  - Waves of faunal expansion / isolation
- Invasions on temporal scales linking evolutionary to ecological time
- Spatial scales from landscapes to regions
- Faunal mosaics in space and time


Natl. Geographic Magazine

Arctic Parasite Stories-

- Key ecological drivers, shaping ecosystems
- Disease agents, wildlife and humans
- Food safety, food security, sustainability
- Historical ecological/ biogeographic indicators
- Indicators of ecological stability and change
  - Conditions on distant flyways/ staging areas
  - Altered phenology, Mismatches, Trophic shifts
  - Invasions, Faunal mixing, Emergence
  - Interfaces and Ecotones


Marine
Anisakis
Diphyllobothrium
Trichinella
Toxoplasma
Mercury
PCB's
Aquatic
Diphyllobothrium
Giardia
Cryptosporidium
Toxoplasma
Mercury
PCB's
People
Salmon/
Ichthyophonus
Echinococcus
Trichinella
Toxoplasma
POP's
Land
Caribou/
Nematodes, Warbles,
Vector-borne disease
Extrinsic
Ecological Setting
Perturbation/ Ecotones
Climate/ Temp & Precipitation
Extreme Events
Mitigation/ Adaptation
Subsistence Food Chains
Interactions/ Determinants
Contaminant Accumulation
Pathogen Distribution & Disease
Food Security/ Food Safety
Intrinsic
Host Demography
Condition/ Susceptibility
Immunology
Pathogen Life History
Evolution
Matrix of Forcing Through Accelerating Climate Warming

Jokül Sarlon
Southern Iceland
2004

Climate Change Consequences

Climate change is eliminating ecological barriers & constraints on development & distribution for pathogen transmission.

Creates New Conditions.

Maps for distributions of hosts, pathogens & diseases will be redrawn.

Emergence of diseases & unanticipated "cascades" can drive perturbations in terrestrial, marine & aquatic ecosystems.

Outcomes of Climate Warming

- Northern biotic expansion
- Ecosystems in collision/ faunal mixing
- Host switching by parasites at interface of newly emerging ecotones
- Altered developmental thresholds
  - Shift in permissive environments
  - Accelerated development/ amplification
  - Extinctions related to resilience

Why We Need Archives?

- "The Past is the Key to the Present"
- Ecosystems in collision
- Environments in Rapid Transition
  - Indicators of loss, introduction, stability
  - New ecological associations
- Permanent Record of Faunal Structure
- Baselines to Assess Stability & Change
- Historical Explanations Matter


Surveillance
Ecosystem Integrity
Conservation
Management
Host Specimens
Pathogen Specimens
Tissues/Vouchers
Archival Collections
Geo-Referenced Data
Biodiversity Informatics
Prediction
Microparasites
Macroparasites
GIS
Ecological
Modeling
GenBank
Baselines
Research
Diagnosis
Integrated Pathways Describe the Biosphere
Hoberg, Kutz et al. ABA, 2013

Transboundary Pathways

Landscapes → Information Webs

Integrating Specimens - Observations

Ecosystems - Faunas – Species – Populations

Informatics Cross-Disciplinary Synergy

Archives for Biodiversity – Geography - Genetics - Genomics

Baselines, Surveillance, Temporal-Spatial Modeling

Using/Developing Information Linking TEK to Research Networks

Physical Processes ⇝ Biological Outcomes

Tracking/ Anticipating/ Mitigating

Change Over Space and Time

Matakiel Is., Sea of Okhotsk, August 1988